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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/746,064	12/26/2000	Mizuhisa Nihei	001701	1990

7590

06/10/2002

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EXAMINER

BAUMEISTER, BRADLEY W

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 06/10/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.
09/746,064

Applicant(s)
Nihei et al.

Examiner
B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Apr 5, 2002
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on Apr 5, 2002 is: a) ☒ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ 6) ☐ Other:

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DETAILED ACTION

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 U.S.C. § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-9 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant has amended claim 1 to now add a limitation relating to the free energy of formation of the oxide employed relative to that of an oxide made from an element constituting the underlying semiconductor. The specification does not provide any support for this limitation. Granted, various ones of the elements recited in the specification (see page 5, lines 34 and 35) and listed in claim 2 inherently possess this physical characteristic when specifically used with a GaAs substrate, for example. However, this new limitation additionally reads on other, additional metal oxides that were not recited or disclosed in the specification (see Applicant's attachment submitted in paper #6, filed 4/12/2002, which teaches that the absolute

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value of the Gibb's free energy of Al_2O_3 , for example, is greater than that of Ga_2O_3). Further, of those elements that were recited in the specification and claims, some do not satisfy this condition. Note particularly, TiO_2 and CoO , which this attachment teaches have smaller absolute Gibb's values than does Ga_2O_3 . Accordingly, there is no express, implied or inherent teaching in the specification that would support this new claim language.

Claim Rejections - 35 U.S.C. § 102

4. Claims 1, 3 and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Shimakura '003 (made of record in the previous Office Action). In the BACKGROUND section, Shimakura recites that MESFETs have previously been made by inserting an Al_2O_3 tunneling insulating layer between the gate and the InP substrate (Col. 2, lines 14-19). Please see the Attachment to Applicant's amendment (paper #6) wherein it discloses that Gibb's energy of Al_2O_3 is -1582.3 and that of In_2O_3 is -830.7.

5. Claims 1-3 and 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Lucas et al. '820. Lucas discloses Ti or Ta gates 20 formed over GaAs substrates 12 wherein the gate is separated therefrom by a gate-metal-oxide (TiO_x or TaO_x) layer 18.

6. Claims 1 and 2 are rejected under 35 U.S.C. 102(b) as being anticipated by Imaizumi et al. '717. Imaizumi discloses MESFETs having Schottky gate electrodes formed over III-V

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semiconductor layers with a thin metal oxide interposed therebetween. The oxides may be formed of various metals such as Ti, Co or Ni.

Claim Rejections - 35 U.S.C. § 103

7. Claims 3, 4 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants Admitted Prior Art in view of Imaizumi et al. '717 as applied to the claims above.

a. Applicant acknowledges that it was known to make metal gate MESFETs and HEMTs with S/D and G contacts that are composed of Ti/Pt/Au (see e.g., prior art FIG 1 and the BACKGROUND OF THE INVENTION portion of the specification). Applicant does not disclose that it was known to further provide metal oxides interposed between the metal gate and the channel.

b. Imaizumi discloses MESFETs having Schottky gate electrodes formed over III-V semiconductor layers with a thin metal oxide interposed therebetween. The oxides may be formed of various metals such as Ti, Co or Ni. Further, while Imaizumi provides express examples of InP based semiconductors, the teachings are not so limited. Rather, the reference expressly states that the invention may be employed in other III-V semiconductor systems (col. 6, lines 1-3). It would have been obvious to one of ordinary skill in the art at the time of the invention to have employed a metal oxide as taught by Imaizumi at the metal gate/semiconductor interface of the prior-art

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MESFET or HEMT for the purpose of reducing the leakage current and increasing the breakdown voltage as taught by Imaizumi (e.g., ABSTRACT).

c. Regarding claims 3 and 4, regardless of whether Imaizumi expressly recites whether the oxide is stoichiometric or not, it was well known to those of ordinary skill in the art at the time of the invention that whether the oxide's composition is stoichiometric depends on the oxidation times and conditions, and no unexpected results would result from using one vs the other.

8. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted Prior Art--Imaizumi et al. '717 as applied to the claims above and further in view of Kirchner et al. '450 (previously made of record). Imaizumi teaches that the oxide may be interposed between the gate and the semiconductor, but does not further teach that it may be employed over other regions of the surface.

a. Kirchner discloses FETs having a tunneling oxide insulating layer interposed between the gate and channel. Further, various embodiments depict that the oxide may be formed under the S/D regions (FIG 9) and may cover the entire surface (FIG 10). It would have been obvious to one of ordinary skill in the art at the time of the invention to have further employed the tunnel metal oxide as taught by Applicant's Admitted Prior Art--Imaizumi under the S/D regions as taught by Kirchner for the purpose of preventing metal from diffusing therefrom into the

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semiconductor. It would have been further obvious to coat the entire surface for the purpose of simplifying the masking design.

Response to Arguments

9. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Lucas et al. '820 teaches FETs having TiOx interposed between a GaAs substrate and a Ti or Ta gate.

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period

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will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

INFORMATION ON HOW TO CONTACT THE USPTO

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at (703) 306-9165. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

B. William Baumeister

Patent Examiner, Art Unit 2815

June 6, 2002



EDDIE LEE
SUPERVISORY PATENT EXAMINER
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